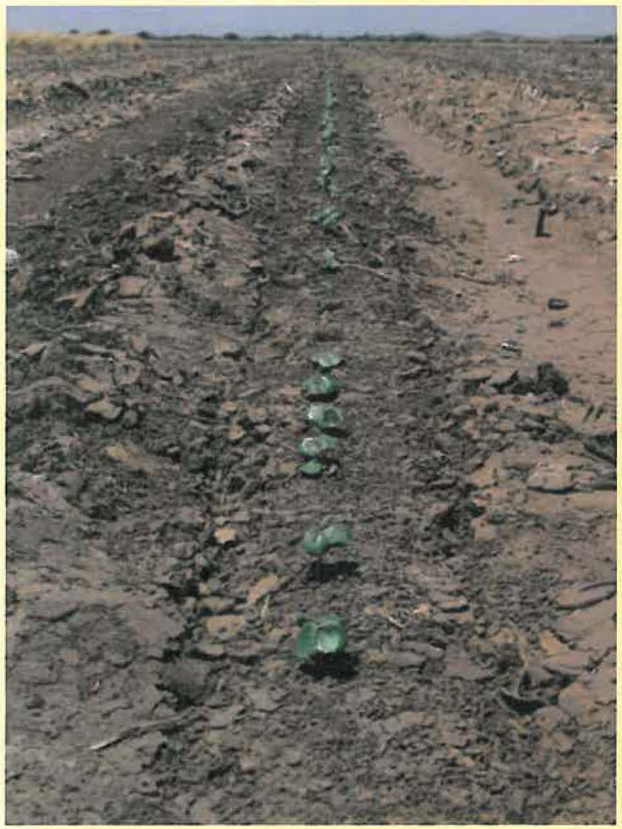
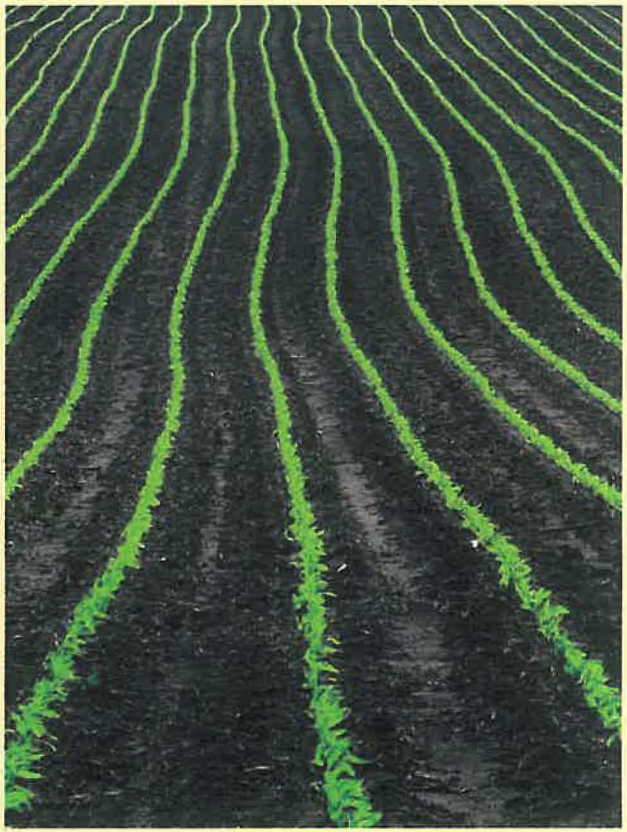
Soil Nutrient Mass Balance Study





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Why soil organic matter?

-positively correlated w/ ***yield amount***

-positively correlated w/ ***yield stability***

-positively correlated w/ ***water holding capacity***

Soil Nutrient Mass Balance Study

1. What's the status of carbon & nutrient ***soil stocks***?

2. Are carbon, nitrogen, and phosphorus ***soil stocks*** on the decline?

3. Why the uncertainty?

Soil nutrient & carbon stocks:

Balance of inputs and outputs:

nitrogen inputs – nitrogen outputs = **Δsoil storage**

Two Approaches

nitrogen inputs – nitrogen outputs = **Δsoil storage**

1. Measure the inputs and outputs

   inputs – outputs = **Δsoil storage**

2. Measure soil stock at two points in time

   soil stock at time B – soil stock at time A = **Δsoil storage**

Significant Uncertainty with Both Approaches

Inputs Minus Outputs

1. Not all inputs outputs can be measured
2. Inputs and outputs interdependent
3. Large year-to-year variability due to climate

Change in Soil Stock

1. Changes over time are small relative to stock size (typically <1%) while analytical accuracy ~2-5%
2. Huge spatial variability in stock size within a field (30-50%)
3. Type II Statistical Errors

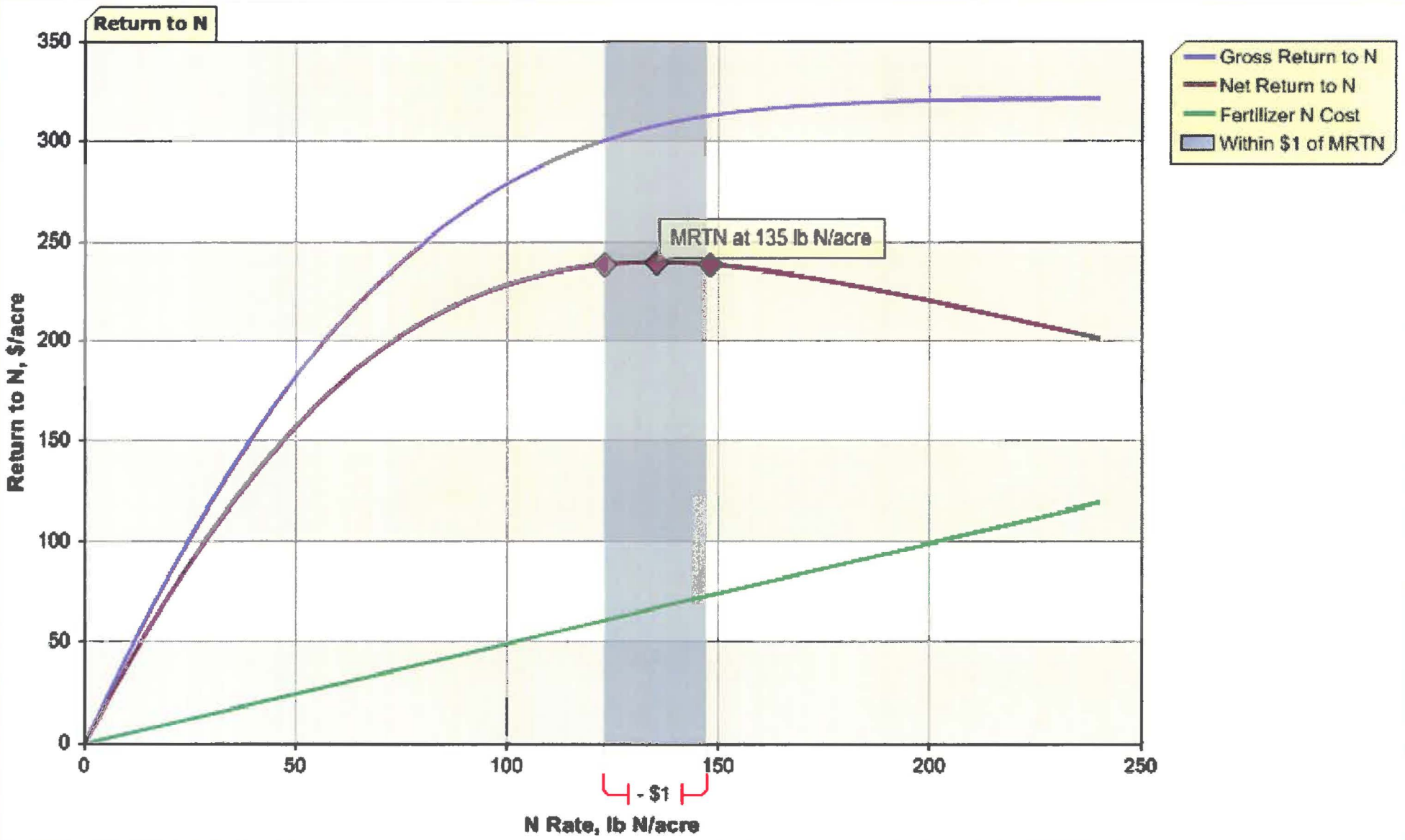
Our Approach:

- **No manure or erosion**
- **Phosphorus**
  - input – output
- **Nitrogen**
  - input – output
  - soil stock in 2009 – soil stock in 1999
- **Carbon**
  - soil stock in 2009 – soil stock in 1999

Input-Output Assumptions - Nitrogen

- Three N fertilizer inputs
  1. Maximum Return to Nitrogen (economic optimum)
  2. $-1/acre below MRTN
  3. $-1/acre above MRTN

- Fluxes were generally means from the literature with some adjustments based on N input rate



http://extension.agron.iastate.edu/soilfertility/nrate.aspx

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Nitrogen Balance

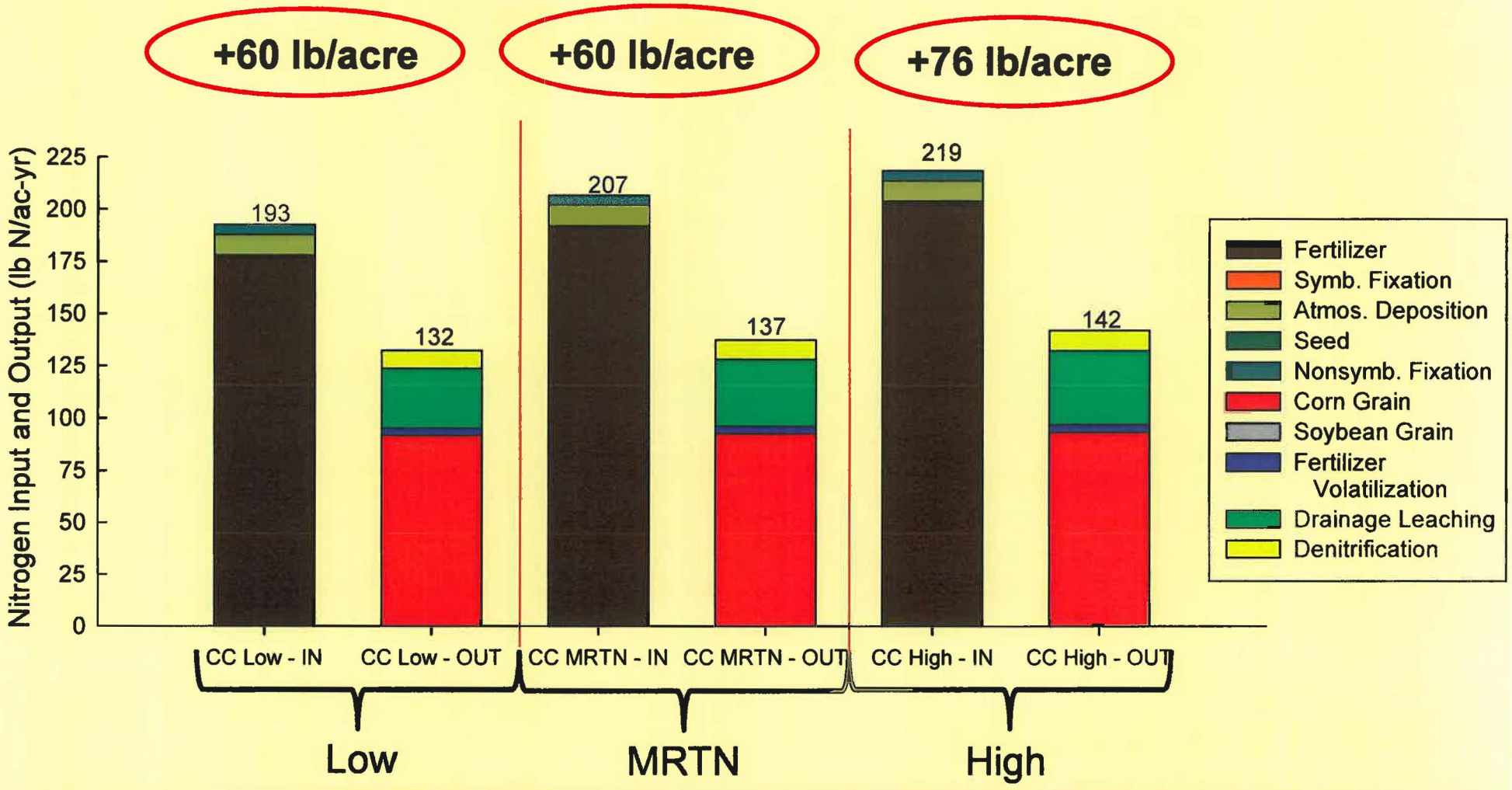
Inputs

- Fertilizer
- *Biological N Fixation*
- *Atmospheric Deposit.*
- *Non-symbiotic Fixation*
- Seed

Outputs

- Grain
- *Leaching*
- *Denitrification*
- *Volatilization*

Continuous Corn (Input-Output)



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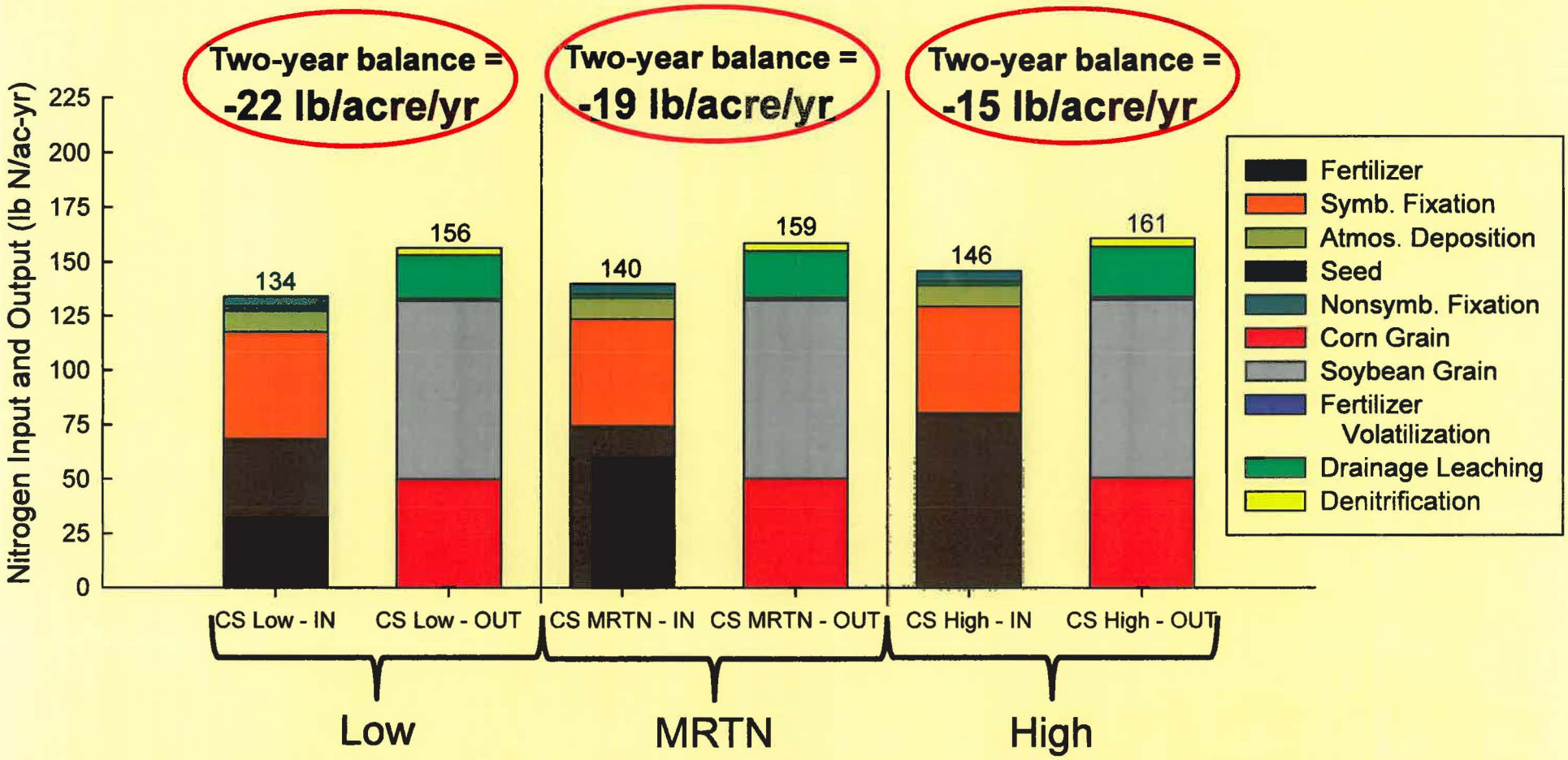
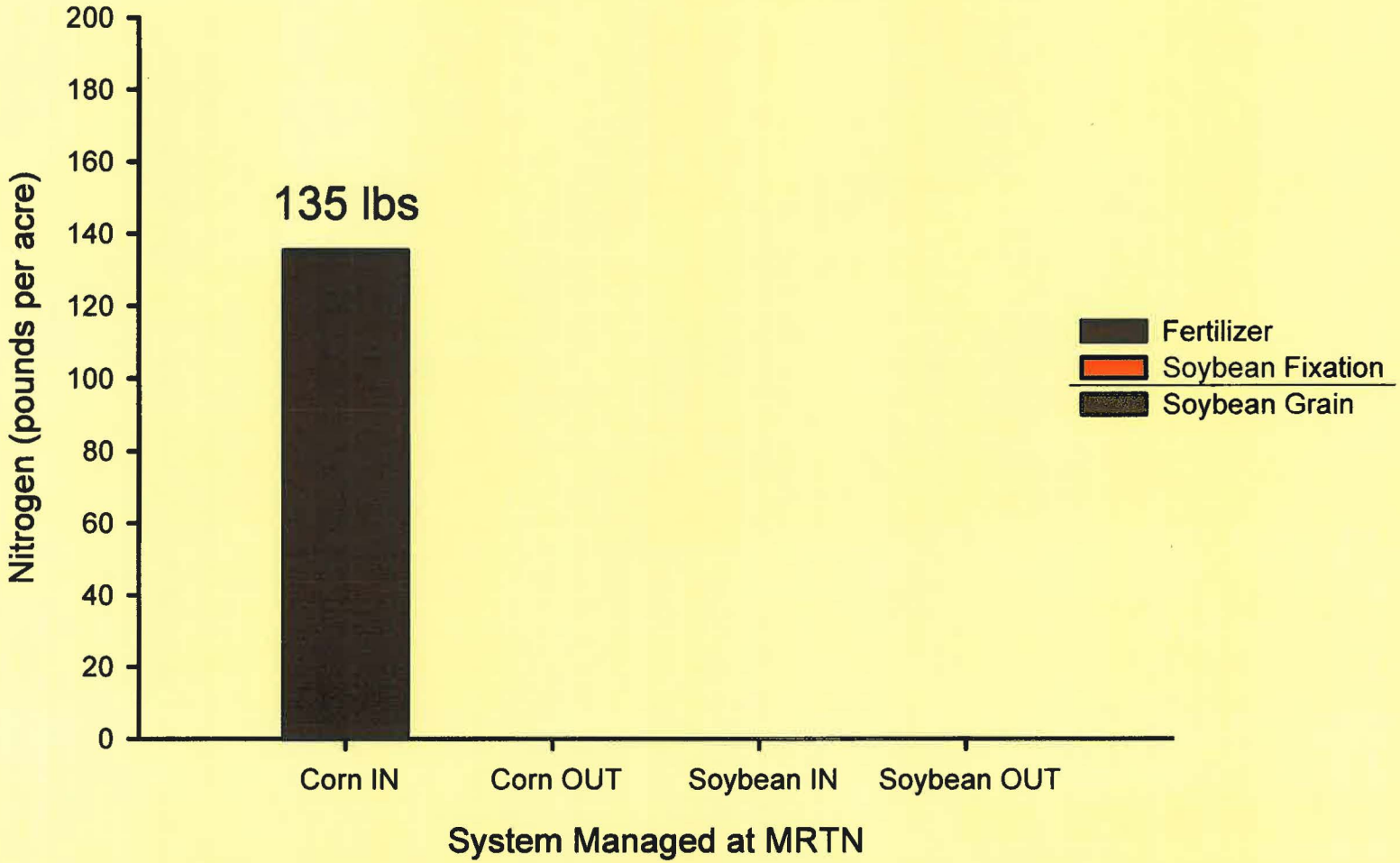
Corn-Soybean (Input-Output)



Corn-Soybean (Input-Output) Partial Balance



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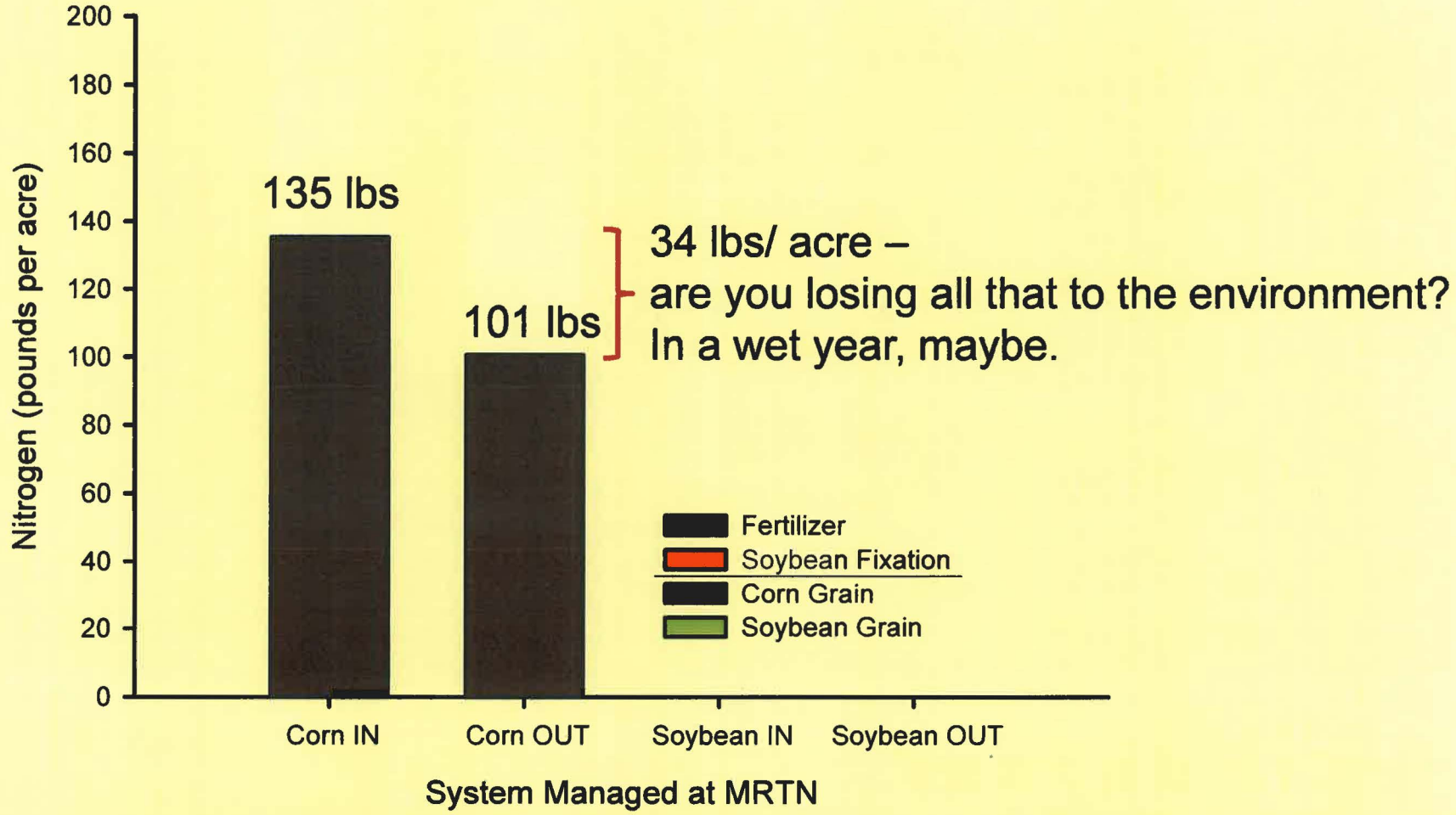

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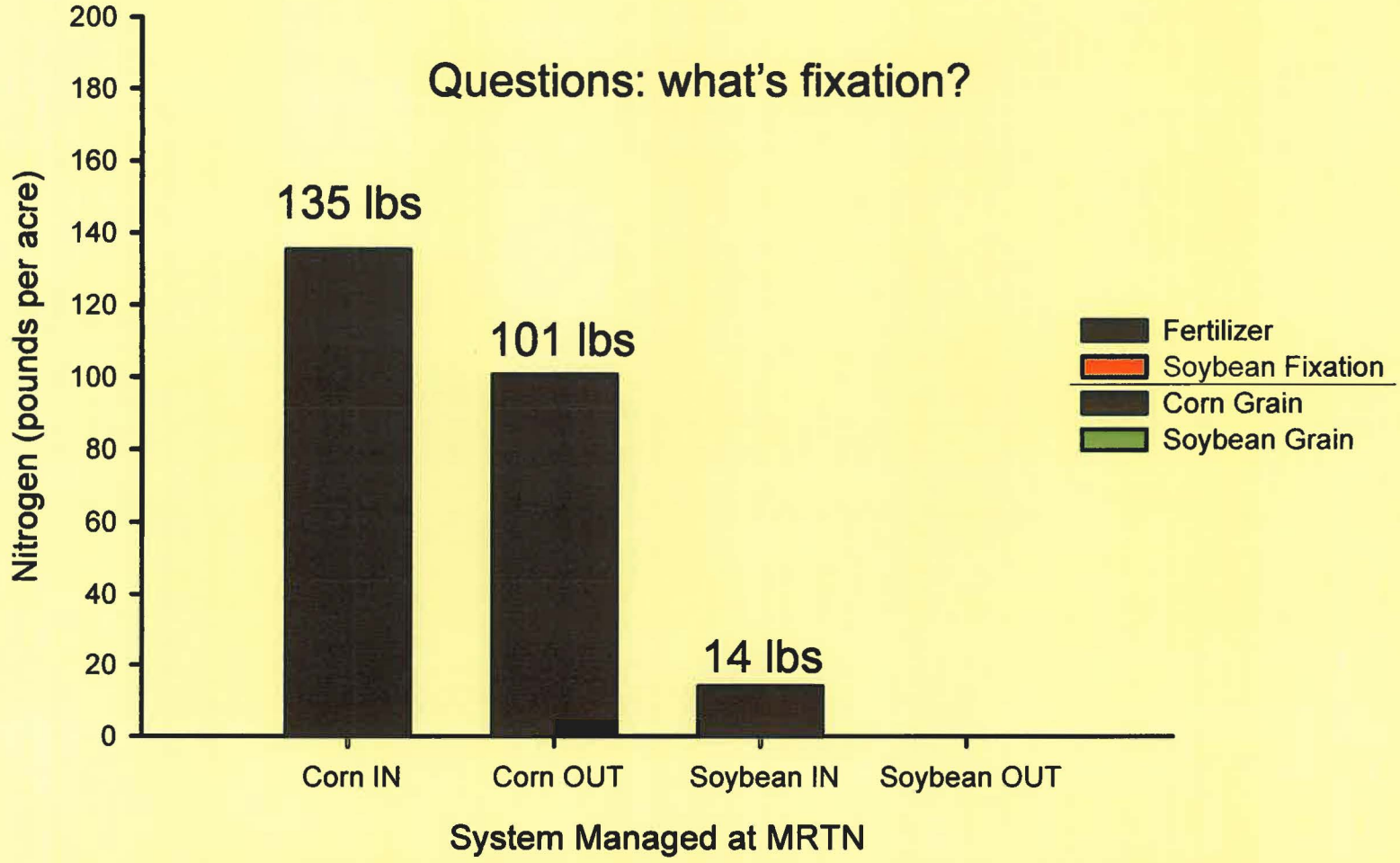

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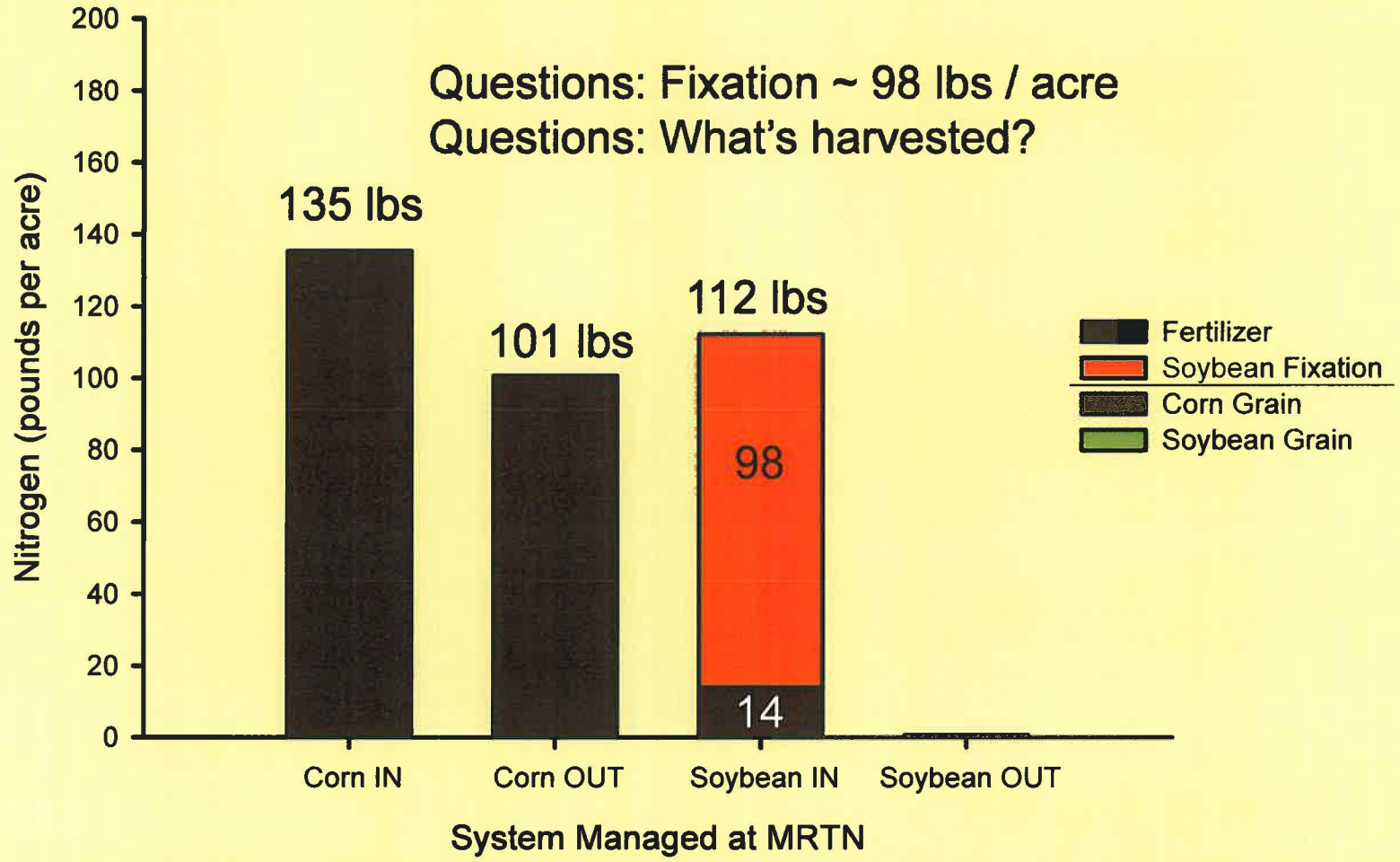

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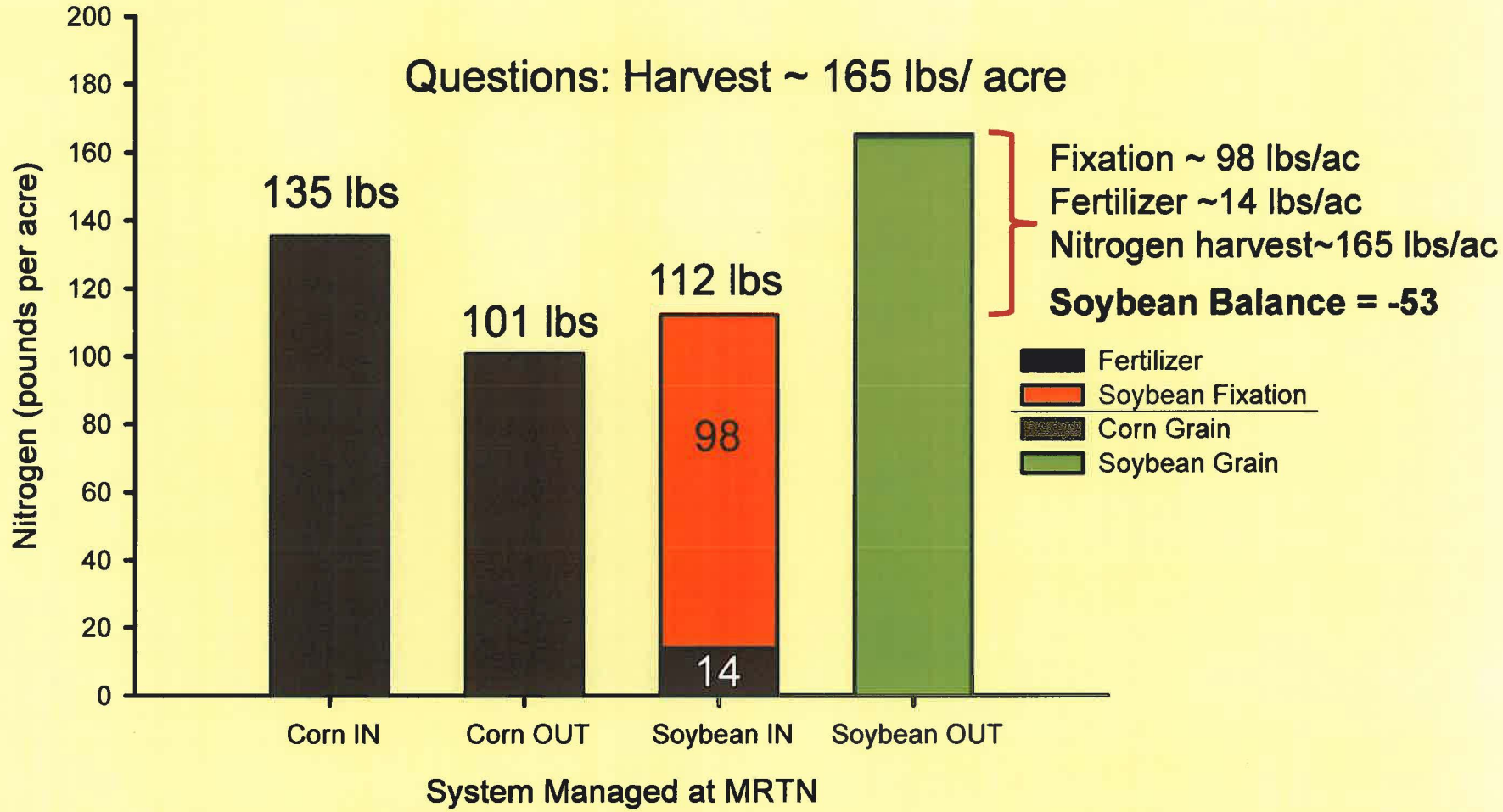

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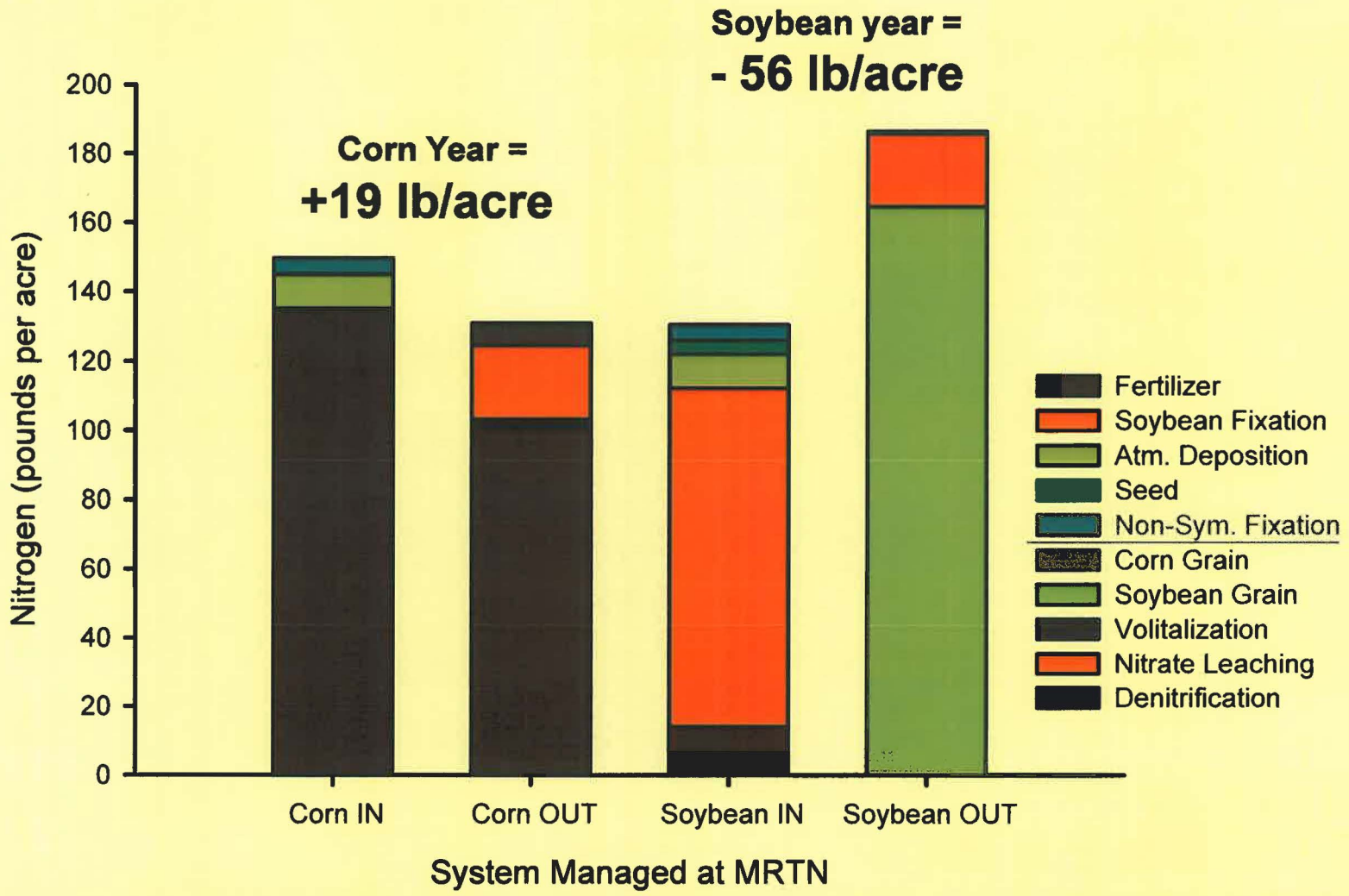

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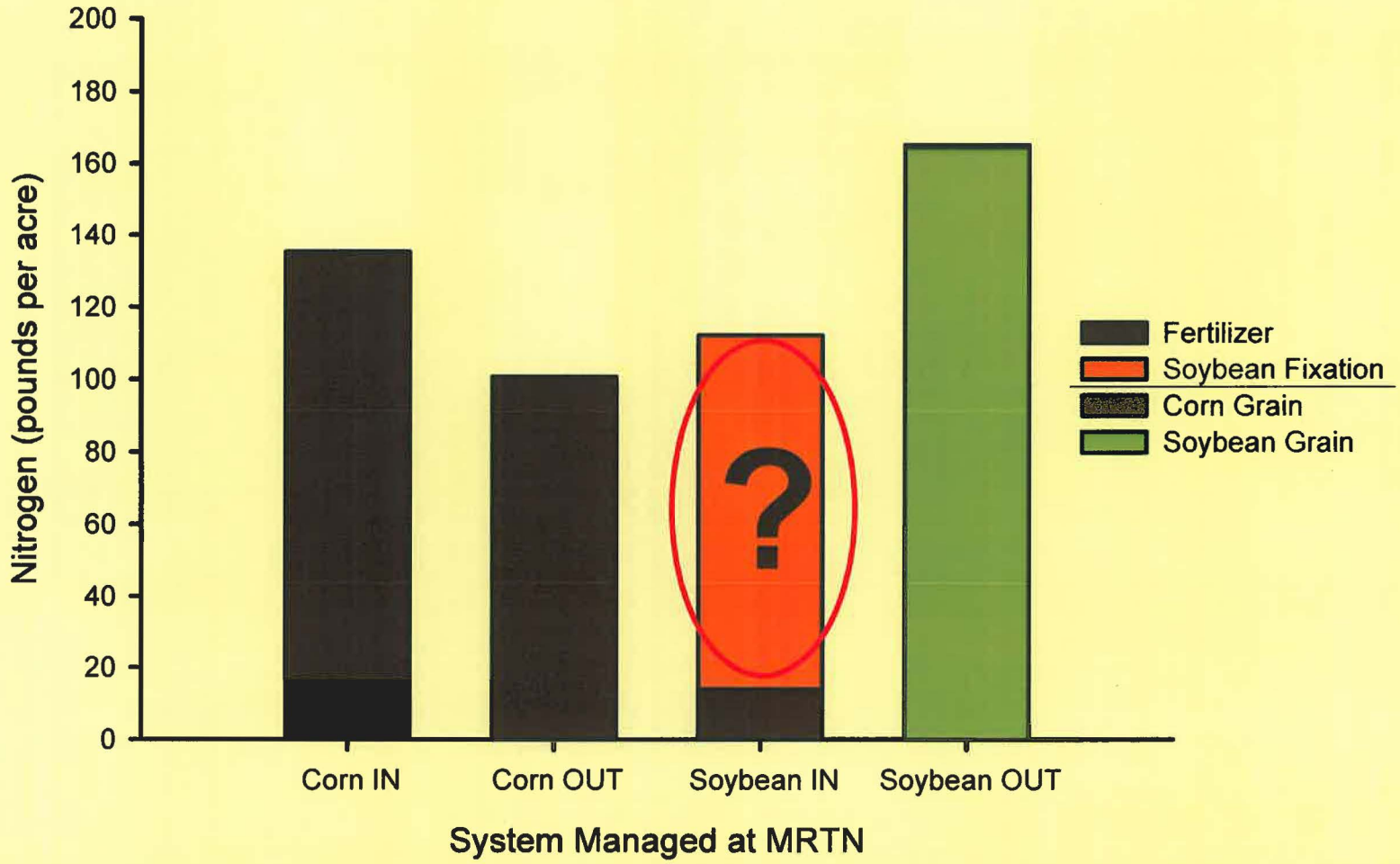

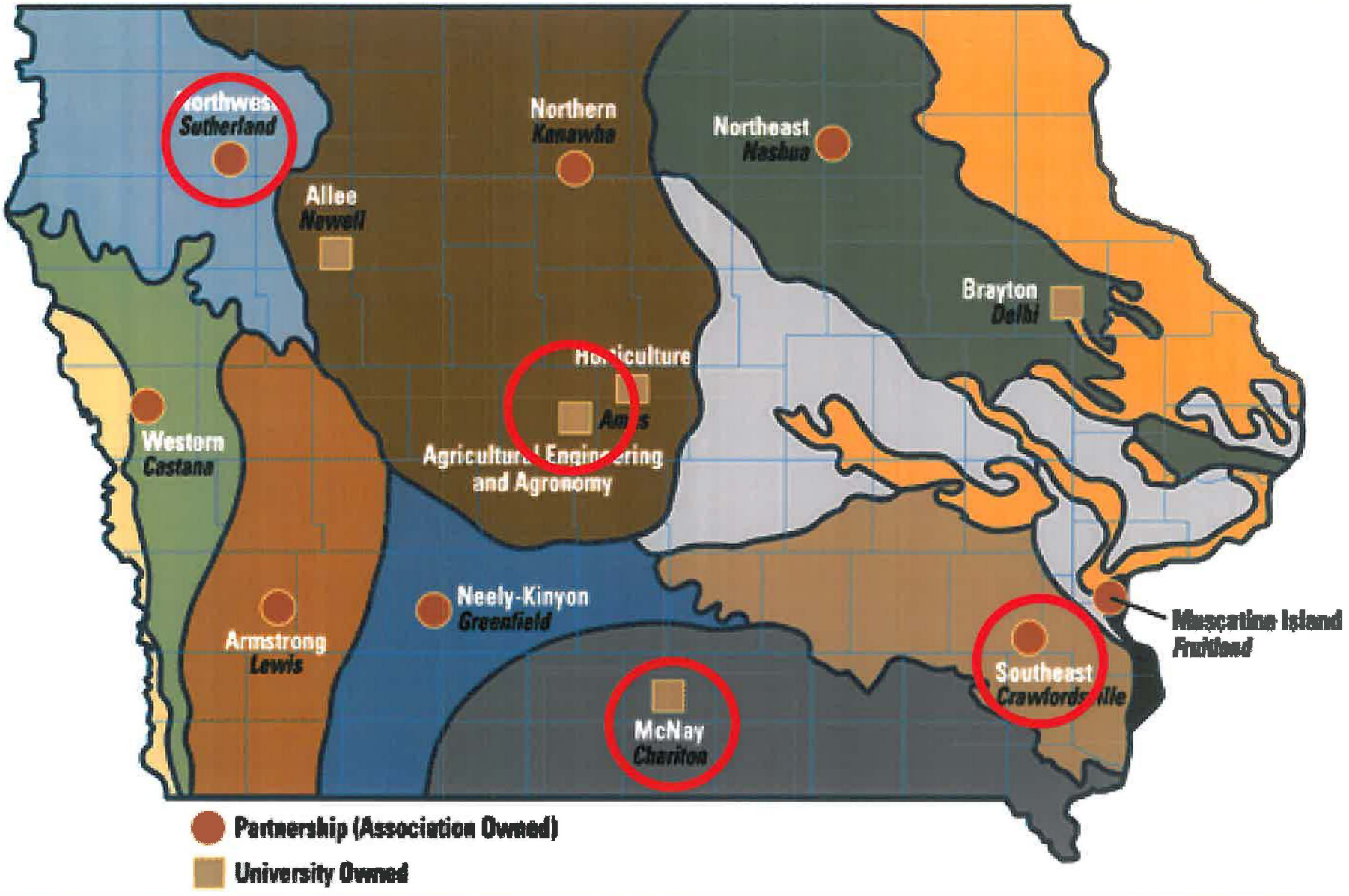

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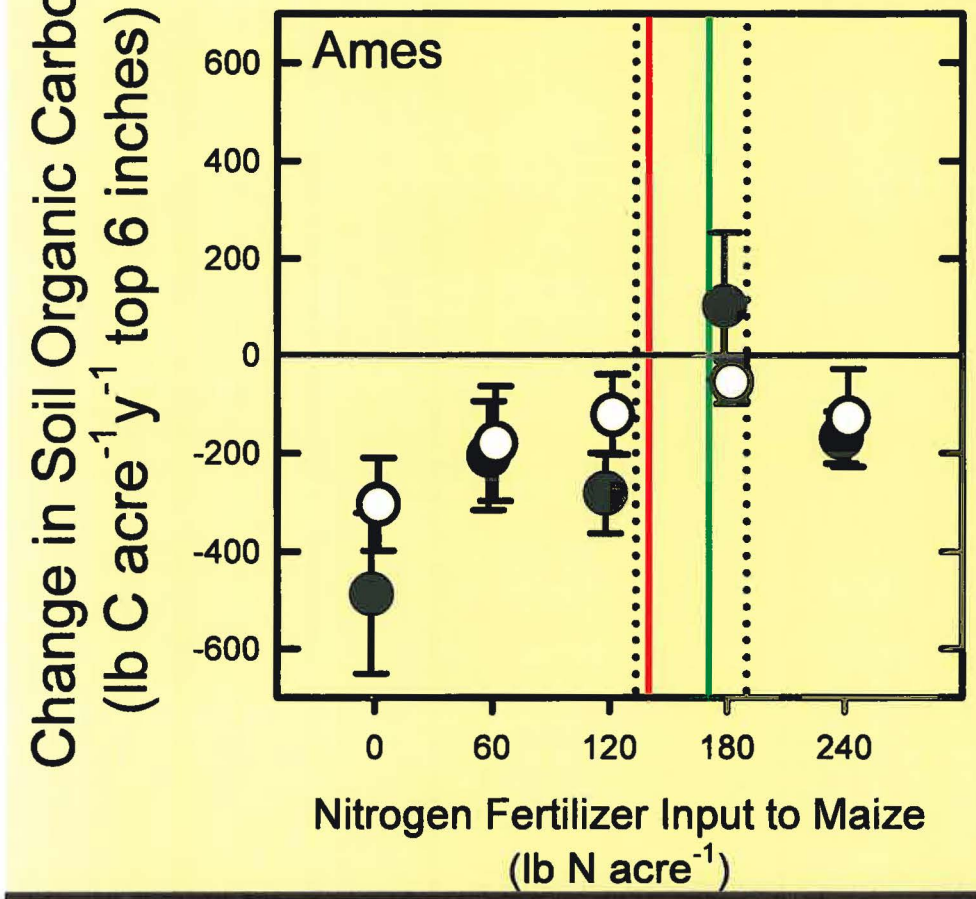
● Continuous Corn

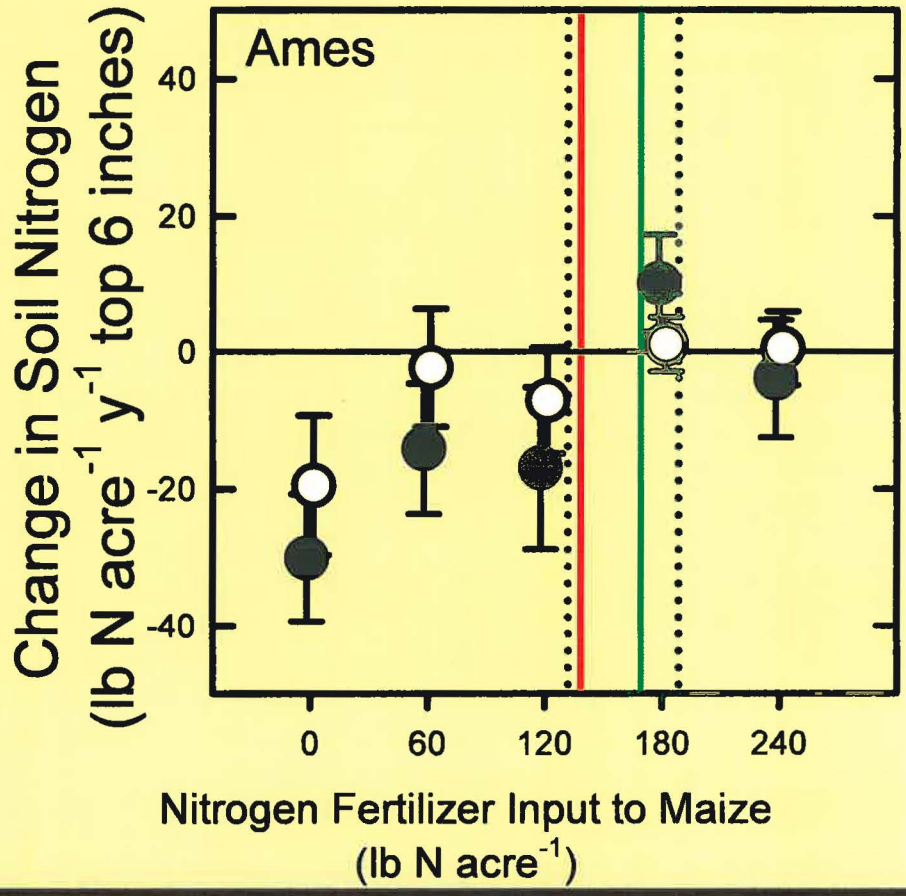
○ Corn-Soybean

Continuous Corn MRTN (empirically calculated for this site)

Corn-Soybean MRTN (empirically calculated for this site)

MRTN at 0.1 price ratio modeled from the Iowa State University N rate calculator (135 lb N/ha for corn-soybeans, 192 lb N/ha for continuous corn).





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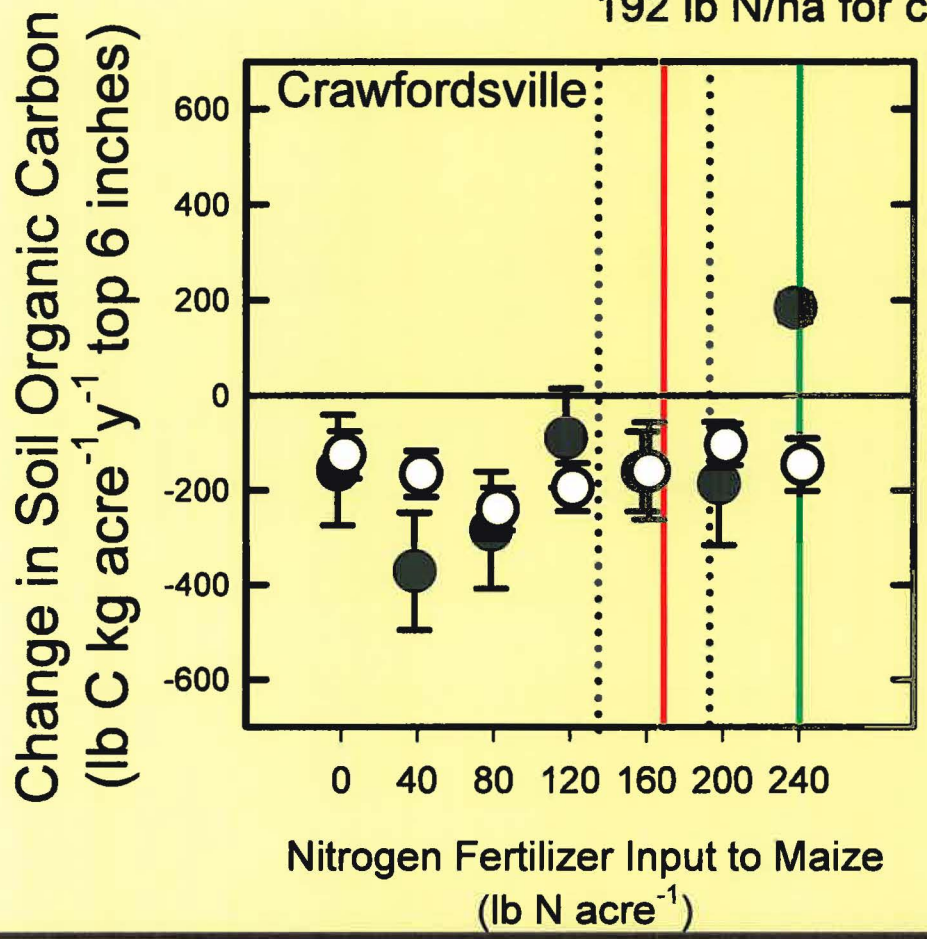

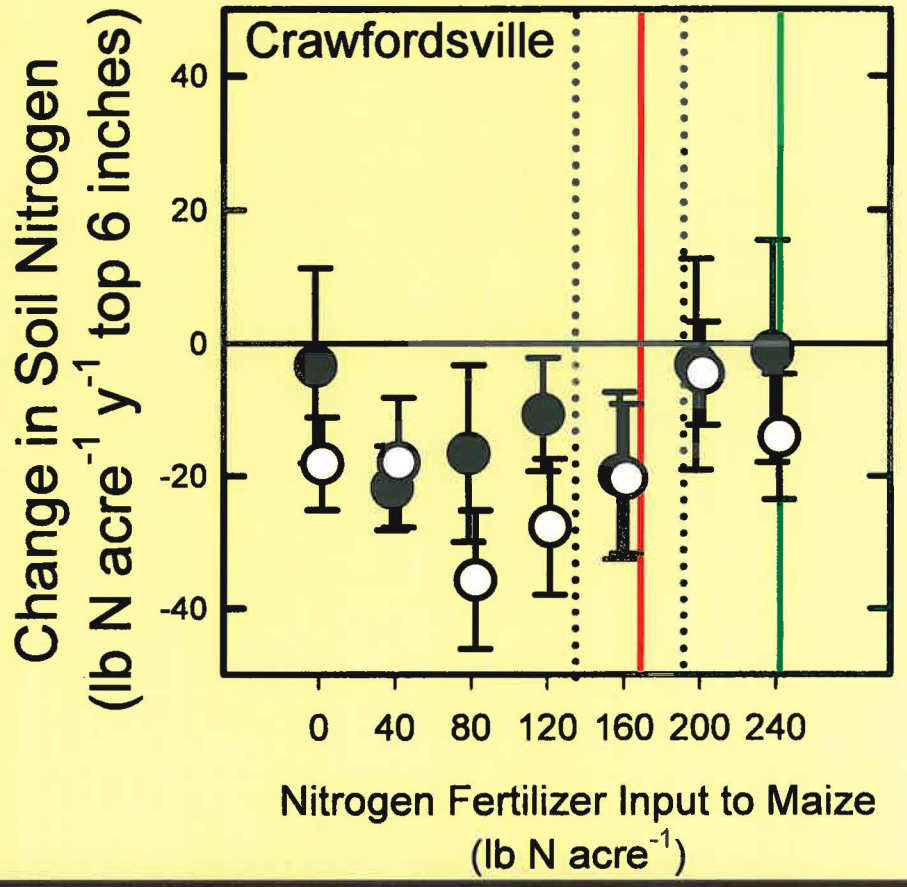

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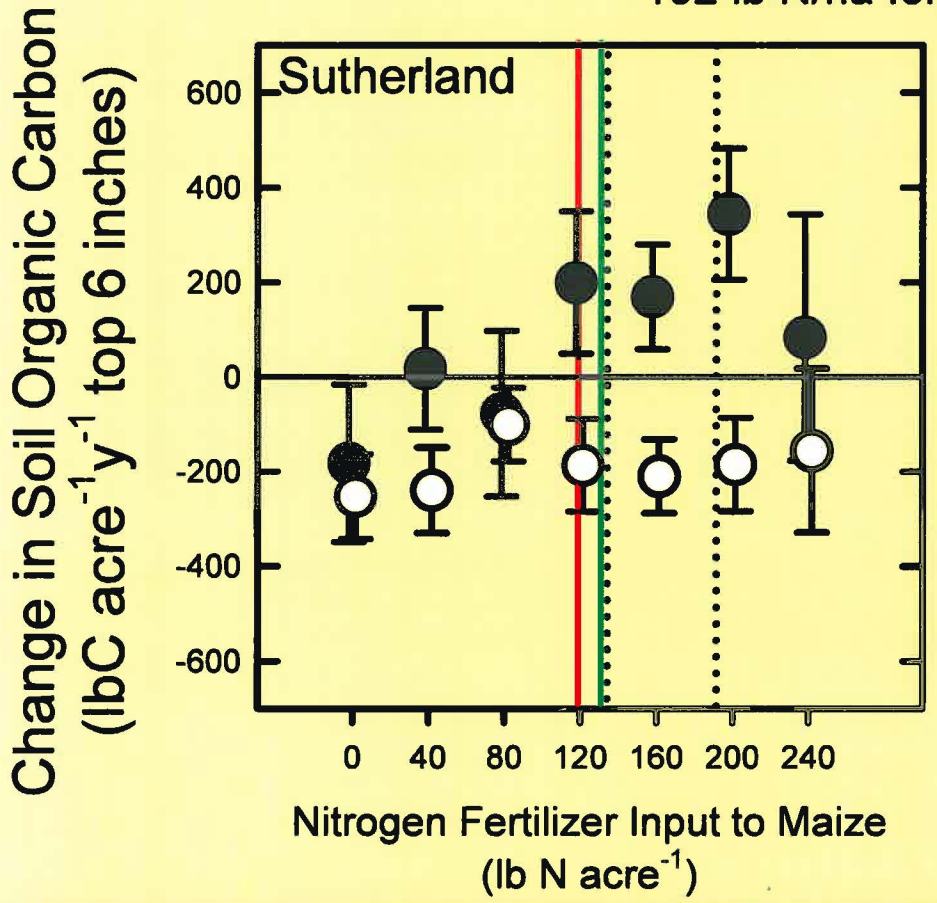

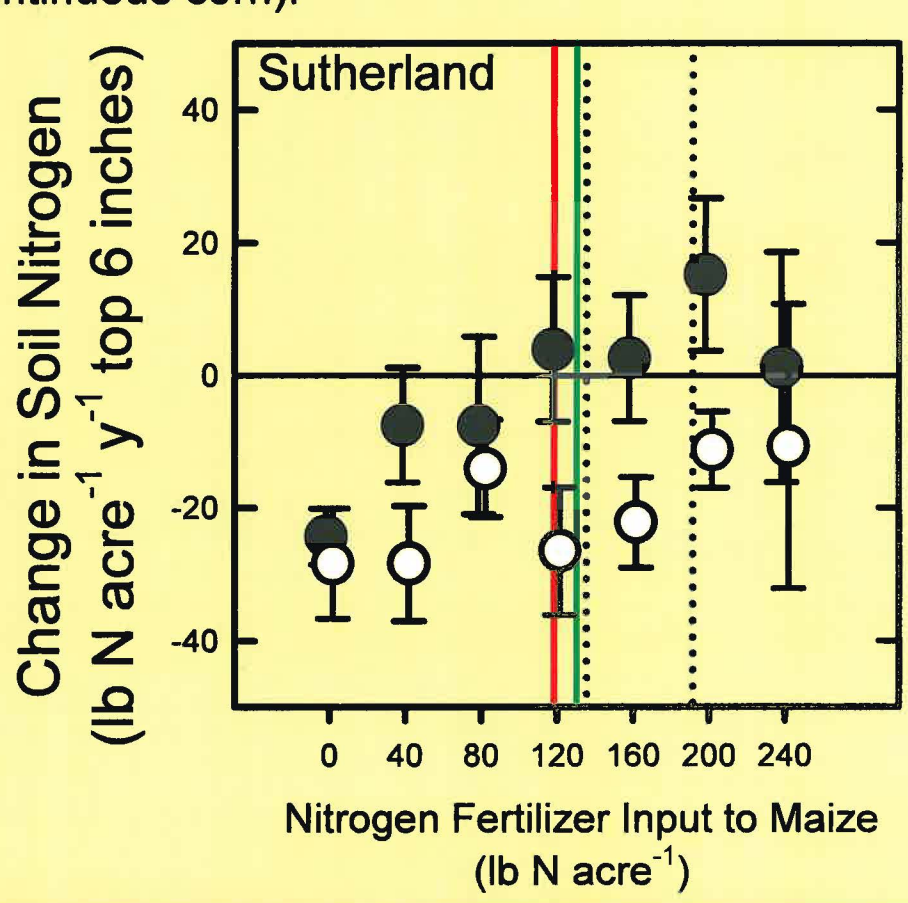

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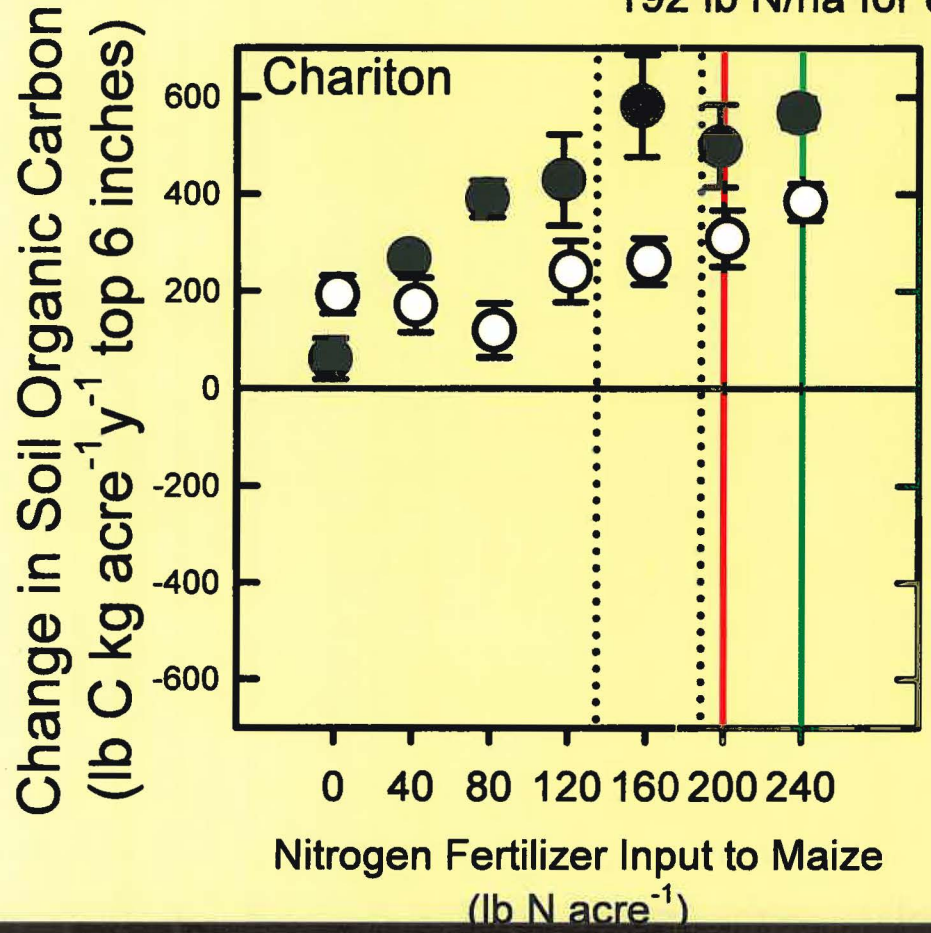

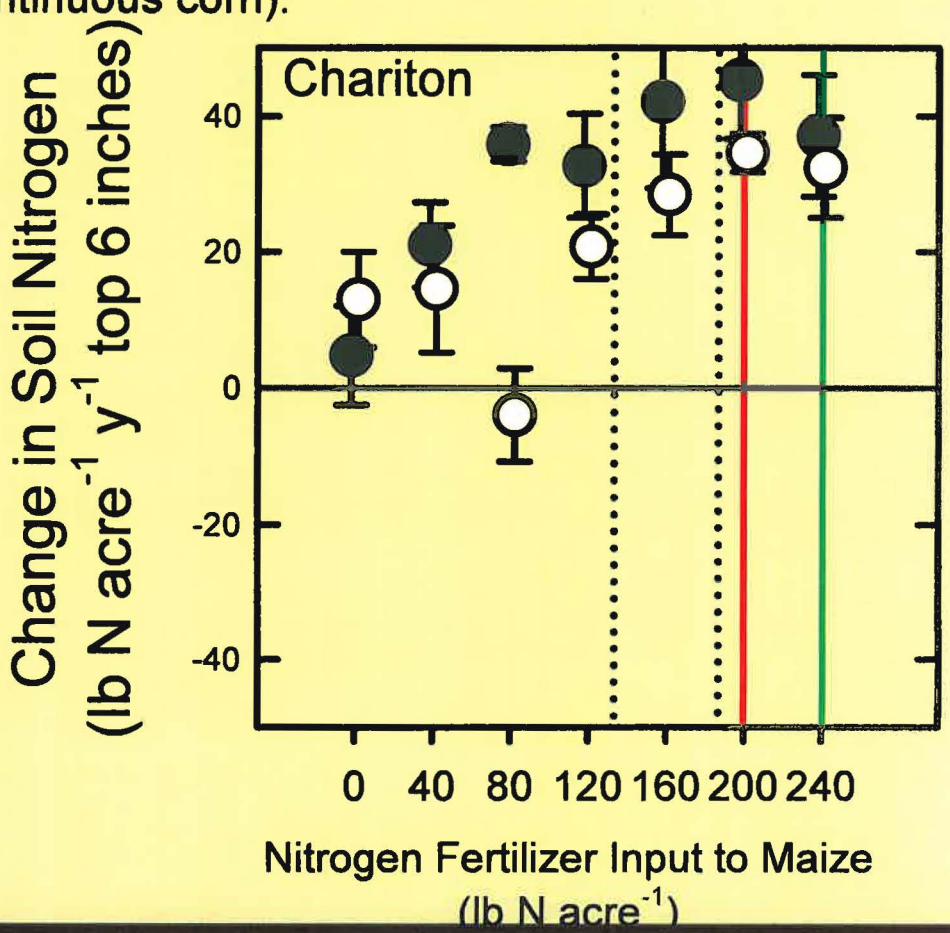

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- Soil organic matter is the largest ***source*** for crop N uptake and the largest ***sink*** for N fertilizer inputs

- Thus: If soil organic matter stocks decline, water quality improvements become more difficult

- Tremendous variation in soil nitrogen stocks and sustainable nitrogen fertilizer rates remain unexplained

- Long-term nitrogen rate experiments are required to accurately:
  1. Assess the status of Iowa's soil nutrient stocks
  2. Optimize nitrogen fertilizer inputs for environmental quality and agricultural productivity

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